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Budgeting and Control of Department of Defense
Expenses Through Variance Analysis

by

Capt David E. Amthauer

ABSTRACT

Supply and personnel costs consume more than half of the Department of Defense annual budget. To insure effective management of these critical resources, supervisors at all levels must participate actively in cost management and control. However, existing reports and procedures do not isolate costs sufficiently for first-line supervisors to meet his/her share of this responsibility. This research proposes a system of variance analysis to meet this deficiency. In this system the senior managers maintain broad control through assigning budget targets, while the first-line supervisors manage daily expenses through monitoring deviations from these targets.

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BUDGETING AND CONTROL OF DEPARTMENT OF DEFENSE
EXPENSES THROUGH VARIANCE ANALYSIS

BY

CAPTAIN DAVID E. AMTHAUER, 1948-

A THESIS

Presented to the Faculty of the Graduate School of the

UNIVERSITY OF MISSOURI-ROLLA

In Partial Fulfillment of the Requirements for the Degree

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ABSTRACT

Supply and personnel expenses consume more than half of the Department of Defense annual budget. To insure effective management of these critical resources, supervisors at all levels must participate actively in cost management and control. However, existing reports and procedures do not isolate costs sufficiently for the first-line supervisor to meet his/her share of this responsibility. This research proposes a system of variance analysis to meet this deficiency. In this system the senior managers maintain broad control through assigning budget targets, while the first-line supervisors manage daily expenses through monitoring deviations from these targets.

PREFACE

This author became aware of the need for new financial management techniques within the Department of Defense while serving as funds manager to the 388th Civil Engineering Squadron (USAF), Korat Royal Thai Air Force Base, Thailand. He was responsible for insuring that the supply expenses incurred by the 20 maintenance shops did not exceed a \$135,000 monthly budget target. Since he was in a staff position, he had to rely on the cost control measures of each shop supervisor in order to stay within budget allocations. The shop supervisors in turn requested budget targets and expense data for each shop in order to monitor their own performance. However, the existing supply cost and budget reports did not isolate costs to the supervisor level and, except through extensive manual manipulation of data, this information could not be provided. Thus, cost monitoring and control was essentially the job of the staff level funds manager and not the line-level shop supervisor.

As part of his duties at his next assignment, the author inspected financial management for base facility maintenance units for Strategic Air Command. Although the associated systems were more highly automated, interviews with shop supervisors and financial management personnel indicated that the reports still were not providing the detail of information required for first-line supervisors to manage day-to-day financial expenses accurately. Where they were it was only through manual tabulations and record keeping.

This author, therefore, began searching for a system that would (1) be easy to automate, (2) be applicable to a wide range of activities, and (3) provide first-level supervisors with the information required to manage their expenses. After research and formal education, the author concludes that variance analysis techniques best meet these requirements.

In presenting the results of this study, the author has made conscientious effort to use inclusive language, as is consistent with current Air Force policy. The following serves the reader as a guide to those common terms that were altered to meet this purpose.

Terms Used in the Text

Familiar Terms

Crafthour.....	Manhour
Shop or Line Supervisor.....	Foreman
Worker.....	Man/Craftsman

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I. INTRODUCTION

In the past 15 years, Department of Defense (DoD) supply and personnel expenses have consumed a rapidly increasing proportion of overall DoD appropriations.¹ Now more than half of the DoD budget,² these two items must be managed more effectively than ever if the armed forces are to meet future mission requirements. Success in this task rests heavily on the first-line supervisors³ since their decisions most directly determine how efficiently these resources are used.⁴

Line supervisors, however, do not have adequate information available to fulfill this responsibility. As this research will demonstrate, existing budget, supply, and labor reports fail to (1) provide the manager with understandable, pertinent data, (2) present the financial impact of managerial decisions not directly related to expenditures, (3) provide for early detection and correction of potential problem areas, and (4) motivate and involve the first-line supervisor in day-to-day financial management.⁵ Consequently, reports were more applicable to organizational level managers than to first-line supervisors. As a result the organization's staff funds manager assumed more of the responsibility for monitoring and disbursing funds. Thus, both control and obligating authority for financial matters became highly centralized.⁶

This study proposes adopting the concept of variance analysis to meet these deficiencies. In surveying the literature and past initiatives in this area, the text defines the

concept of variance analysis and describes the variable budget model for the system. Equations for each proposed variance are developed and applied to a specific example. Finally, using this example, this study will demonstrate the aforementioned shortcomings and will show how variance analysis can overcome these difficulties and can again involve the first-line supervisor in the day-to-day financial well-being of the organization.

II. REVIEW OF LITERATURE

A. CONCEPTUAL DEFINITION

As used by industry, the variance analysis technique assigns standard cost targets to an activity, divides and quantifies deviations from those standards into component causes, and assigns each component to responsible manager for correction.⁷ With functions as diverse as the armed forces, standard costing by activity would be prohibitively expensive. However, by substituting an activity's budget target in place of standard costs, variance techniques become a powerful and flexible tool for all levels of management. The key to this substitution is the variable budget.

B. THE VARIABLE BUDGET MODEL

Variable budgeting techniques relate a unit's expenses to some measurement of output through a constant rate factor.⁸ In equation form:

$$\text{BUDGET} = [\text{RATE FACTOR}] \times [\text{PROJECTED OUTPUT}]$$

The rate factor varies considerably with the type of function to which it is applied, a feature that gives variable budgeting exceptional flexibility. For procurement activities the rate could be costs per million dollars of purchase orders; for a service agency it could be costs per 1000 customers served.

Two such systems are in use in the Air Force. One Air Force-wide system projects aircraft maintenance costs on the basis of flying hours. Since each type of aircraft has its

own maintenance cost per flying hour rate, total base maintenance budgets are the total of individual budgets for each type of aircraft.⁹ The other system, developed by Strategic Air Command for civil engineering units, relates base real property and building maintenance budgets to unit's productive hours through the material manhour ratios (hereafter called material crafthour ratios).¹⁰ Individual budgets can be prepared at the lowest level in the organization: the cost center or single-craft shop (e.g. a paint shop); thus, the first-line supervisor is the primary element in the budgeting process. Because of its involving the first-line supervisors and because of its broad applicability of its concept, latter system is the basis for the analysis for the remainder of this thesis.

III. RESULTS AND DISCUSSION

To aid the reader, this section uses the specific example of an Air Force paint shop to demonstrate the development and application of the variable budgeting and variance analysis techniques. The results are summarized on Table I.

A. DEVELOPMENT OF A VARIABLE BUDGET

The variable budget consists of two components based on the type of materials consumed: direct or indirect.¹¹ Direct materials are those items identifiable to and chargeable to a specific project. Materials for a major building renovation, and aircraft engine overhaul, or repairing an accident-damaged motor vehicle would be direct materials. Indirect materials are those items related to overall shop operations and which cannot be assigned directly to a particular project. Bench stock and special protective clothing costs are indirect material costs and are charged against all shop activity on a per productive crafthour basis. Given these two classes of materials the variable budget equations can be developed.

$$\text{BUDGET} = [\text{RATE FACTOR}] \times [\text{PROJECTED OUTPUT}]$$

The rate factor is the material costs per productive crafthour or the material crafthour ratio (MCR) for each type of material. The projected output is the product of the expected number of workers assigned, the total hours each is available for work (usually 2080 hours per year) and the portion of that time available for productive effort

(productivity ratio). For example, a paint shop spends 70 percent of its time in productive activity, the remainder being vacation, sick, overhead, and idle time. If 19 workers were expected to be assigned for the next year, the projected output would be:

$$\begin{aligned}\text{OUTPUT} &= (\# \text{ PERSONNEL}) \times (\text{HOURS/WORKER/YEAR}) \times \\ &\quad (\text{PRODUCTIVITY RATIO}) \\ &= (19) \times (2080 \text{ hrs/worker}) \times (.70) = \underline{27,664 \text{ hrs}}\end{aligned}$$

Past experience has shown that the paint shop consumes \$1.05 in indirect materials for every productive hour, or an indirect material craft hour ratio of \$1.05/hr. Given the variable budget equation, the projected indirect materials budget is:

$$\begin{aligned}\text{BUDGET} &= [\text{RATE}] \times [\text{OUTPUT}] \\ &= [\$1.05/\text{hr}] \times [27,664 \text{ hrs}] = \underline{\$29,047.20}\end{aligned}$$

Determining the budget for direct materials is more difficult in that not all of the shop's productive time is spent on the large jobs requiring direct materials. Periodic maintenance of building equipment, minor building repair, and most aircraft scheduled maintenance, for example, would not require direct materials. Therefore, the projected output factor must be adjusted by the factor representing that portion of time that work will require direct materials. For the example, the shop supervisor determined that only 40 percent of his/her work required direct materials. Thus, the output factor for the direct materials budget is:

$$\begin{aligned}\text{OUTPUT FOR DIRECT} &= [\text{PORTION OF DIRECT}] \times \\ &\quad [\text{TOTAL PRODUCTIVE OUTPUT}] \\ &= [.40] \times [27,664 \text{ hrs}] = \underline{11,065.0 \text{ hrs}}\end{aligned}$$

The supervisor also estimates that direct materials will be consumed at the rate of \$1.85 for every hour of direct material type work. The direct material budget is:

$$\begin{aligned}\text{BUDGET} &= [\text{RATE FACTOR}] \times [\text{PROJECTED OUTPUT}] \\ &= [\$1.85/\text{hr}] \times [11,065.0 \text{ hrs}] = \underline{\$20,471.36}\end{aligned}$$

In summary the shop budget is:

<u>Budget Item</u>	<u>Budget</u>
Indirect Materials	\$29,047.20
Direct Materials	<u>20,471.36</u>
Total	<u>\$49,518.56</u>

At the end of the budget year the budget, supply, and labor reports show the following data:

<u>Budget Item</u>	<u>Budget Target</u>	<u>Actual Figure</u>
Indirect Materials	\$29,047.20	\$27,131.83
Direct Materials	<u>20,471.36</u>	<u>20,214.56</u>
	<u>\$49,518.56</u>	<u>\$47,346.39</u>

No. Personnel Assigned	19.0	20.5
Total Productive Hours	27,664.0 hrs	26,863.2 hrs
Hours for Direct Materials	11,065.6 hrs	11,551.2 hrs

Once budget targets are set, the key issue becomes whether or not the shop expenses are on target, and if not, why not.

The supervisor may also want to know what the financial impact of the shop's labor productivity was. It is exactly

on these issues that variance analysis becomes an excellent complement to variable budgeting.

B. DEVELOPMENT OF VARIANCE EQUATIONS

Variance analysis uses the variable budget equations and measures the difference between the actual and budgeted targets for the rate and output factors. Rate changes are thus caused by changes in the material crafthour ratio; whereas, output changes are caused by differences in the factors of production: number of personnel assigned, their relative productivity, and the portion of the work requiring direct materials. Variances are assigned to each of the above areas and are computed per the equations below. In each section, the budget and actual data listed above will be used to calculate the variances for the paint shop.

1. Material Usage Variance. This variance measures the size of budget deviations due to changes in the material crafthour ratio. Several factors may contribute to these changes: price changes, work force efficiency (more work per productive crafthour), waste, or work complexity (work requiring high cost materials but little labor effort). In any case, the shop supervisor is the person most able to determine the cause and to initiate corrective action. The magnitude of the variance is determined by multiplying the change in the ratio times the actual factor of output.

$$\text{MATERIAL USAGE VARIANCE} = [\text{CHANGE IN MATERIAL CRAFT HOUR RATIO}] \\ \times [\text{ACTUAL OUTPUT FACTOR}]$$

For indirect materials the actual output factor is the total actual productive hours (26,863.2 hours). Since the material crafthour ratio is the ratio of material costs to the output factor, the actual indirect material crafthour ratio is the actual indirect material costs divided by the total actual productive hours or \$1.01/hr (\$27,131.83/26,863.2 hrs). The deviation in the ratio from budget is \$-.04/hr (\$1.01 - \$1.05). Thus the indirect material usage variance is

$$\begin{aligned}\text{INDIRECT MATERIAL USAGE} &= [\text{RATIO CHANGE}] \times [\text{ACTUAL PRODUCTIVE HRS}] \\ \text{VARIANCE} &= [\$-.04/\text{hr}] \times [26,863.2 \text{ hours}] \\ &= \underline{\$-1,074.53}\end{aligned}$$

For direct materials the output factor is the actual hours requiring direct materials (11,551.2 hrs). The actual material crafthour ratio is the actual direct material costs divided by this figure, or \$1.75/hr (\$20,214.56/11,551.2 hrs). With a budgeted figure of \$1.85/hr, the ratio change is \$-.10/hr (\$1.75/hr - \$1.85/hr). The direct material variance is:

$$\begin{aligned}\text{DIRECT MATERIAL USAGE} &= [\text{RATIO CHANGE}] \times [\text{HOURS FOR DIRECT}] \\ &= [\$-.10/\text{hr}] \times [11,551.2 \text{ hours}] \\ &= \underline{\$-1,155.12}\end{aligned}$$

The total material usage variance is then the sum of the two or

$$\begin{aligned}\text{TOTAL MATERIAL USAGE VARIANCE} &= [\text{DIRECT}] + [\text{INDIRECT}] \\ &= [\$-1,155.12] + [\$-1,074.53] \\ &= \underline{\$-2,229.65}\end{aligned}$$

The negative sign indicates that in both direct and indirect materials the shop was using materials at a slower rate than budgeted.

2. Assignment Variance. This variance measures the impact that a change in the number of shop personnel has on budget targets. The primary cause for changes in these figures is an assignment action taken by a higher headquarters. Since military personnel are mostly centrally assigned, variances in this area are beyond the supervisor's control, and in most cases beyond the base's control. This variance is necessary because it quantifies the impact of that external action. An assignment variance can result from local management decision, however, in the case of hires, fires, or transfers to another section. The magnitude of this variance is determined by multiplying the change in the number assigned by the budgeted material crafthour ratio (the effects of that ratio already have been isolated in the material usage variance) and by the actual productive hours worked per worker.

$$\text{ASSIGNMENT VARIANCE} = [\text{BUDGETED MATERIAL CRAFT HOUR RATIO}] \times [\text{CHANGE IN NO. ASSIGNED}] \times [\text{ACTUAL PRODUCTIVE HOURS PER WORKER}]$$

The last figure can be determined by determining the productivity ratio. As listed in Section A, the budget figure is .70. The actual figure can be determined by dividing the total actual productive hours by the total actual hours, the latter being a product of the actual number assigned and the

2080 hours per worker per year (42,640.0 hours = 20.5 x 2080 hours). The half person in the assignment column represents one worker being assigned for only one-half year. The productivity ratio is:

$$\begin{aligned}\text{PRODUCTIVITY RATIO (ACTUAL)} &= \frac{\text{ACTUAL PRODUCTIVE HOURS}}{\text{ACTUAL TOTAL HOURS}} \\ &= 26,863.2/42,640.0 = \underline{.63}\end{aligned}$$

The actual productive hours per worker is then the productivity ratio times the total hours per worker per year (2080 hours), or 1310.4 hours.

The indirect materials assignment variance is

$$\begin{aligned}\text{INDIRECT MATERIALS} &= [\text{BUDGETED INDIRECT MATERIAL CRAFT HOUR RATIO}] \times \\ \text{ASSIGNMENT VARIANCE} &[\text{CHANGE IN THE NO. ASSIGNED}] \times [\text{ACTUAL PRODUCTIVE} \\ &\text{HOURS PER WORKER}]\end{aligned}$$

The change in the number assigned is actual minus budget or 1.5 (20.5 - 19). Thus,

$$\begin{aligned}\text{VARIANCE} &= [\$1.05/\text{hour}] \times [1.5] \times [1310.4 \text{ hours}] \\ &= \underline{\$2,063.88}\end{aligned}$$

For direct materials the equation must be altered to change the actual productive hour per worker to actual direct material hour per worker. This value can be determined by computing the actual portion of work requiring direct materials.

$$\begin{aligned}\text{PORTION REQUIRING DIRECT MATERIALS} &= \frac{\text{ACTUAL HOURS FOR DIRECT MATERIALS}}{\text{TOTAL ACTUAL PRODUCTIVE HOURS}} \\ &= 11,551.2 \text{ hrs}/26,863.2 \text{ hrs} \\ &= \underline{.43}\end{aligned}$$

The actual direct material hours per worker is thus:

$$\begin{aligned} \text{ACTUAL DIRECT MATERIAL} &= [\text{PORTION REQUIRING DIRECT MATERIALS}] \times \\ \text{HOURS PER WORKER} & \quad [\text{ACTUAL PRODUCTIVE HOURS PER WORKER}] \\ &= [.43] \times [1310.4 \text{ hours}] = \underline{563.47 \text{ hours}} \end{aligned}$$

The direct materials assignment variance is

$$\begin{aligned} \text{DIRECT MATERIALS} &= [\text{BUDGETED DIRECT MATERIALS CRAFT HOUR RATIO}] \times \\ \text{ASSIGNMENT VARIANCE} & \quad [\text{CHANGE IN NO. ASSIGNED}] \times [\text{ACTUAL DIRECT} \\ & \quad \text{MATERIAL HOURS PER WORKER}] \\ &= [\$1.85/\text{hr}] \times [1.5] \times [563.47 \text{ hrs}] \\ &= \underline{\$1,563.63} \end{aligned}$$

The total assignment variance is then the sum of the two:

$$\begin{aligned} \text{TOTAL ASSIGNMENT VARIANCE} &= [\text{DIRECT}] + [\text{INDIRECT}] \\ &= [\$1,563.63] + [2,063.88] \\ &= \underline{\$3,627.51} \end{aligned}$$

The positive sign indicates the financial impact of having more personnel assigned than budgeted for.

3. Productivity Variance. This variance measures deviations caused by changes in the percentage of workers available for productive effort. Deviations are caused by changes in non-productive situations: overhead, overtime, non-availability of work, transportation, or supplies, or non-work related military assemblies and exercises. A variance will also be produced if a supervisor attempts to reduce a materials usage variance by recording ("padding") too many productive hours. The shop supervisor is most able to control these unproductive situations. The magnitude of the variance

is determined by multiplying the change in the productivity ratio by the budgeted material crafthour ratio and the budgeted total projected hours available (the effects due to assignments already having been isolated).

$$\begin{aligned} \text{PRODUCTIVITY VARIANCE} = & [\text{BUDGETED MATERIAL CRAFT HOUR RATIO}] \times \\ & [\text{CHANGE IN PRODUCTIVITY RATIO}] \times \\ & \text{BUDGETED TOTAL PROJECTED HOURS} \\ & \text{AVAILABLE} \end{aligned}$$

For indirect materials, the total available hours (budgeted) is the product of the budgeted number of personnel assigned and the number of total hours per worker per year, or 39,520 hours (19 x 2080 hours). The change in productivity ratios is the actual minus the budgeted, or $-.07$ ($.63 - .70$). The productivity variance for indirect materials then is:

$$\begin{aligned} \text{INDIRECT MATERIALS} &= [\text{BUDGETED INDIRECT MATERIAL CRAFT HOUR RATIO}] \times \\ \text{PRODUCTIVITY VARIANCE} & [\text{CHANGE IN PRODUCTIVITY RATIO}] \times \\ & [\text{BUDGETED TOTAL PROJECTED HOURS AVAILABLE}] \\ &= [\$1.05/\text{hr}] \times [-.07] \times [39,520 \text{ hrs}] \\ &= \underline{\$-2,904.72} \end{aligned}$$

For direct materials the above equation is altered by adding the factor indicating the portion of work actually requiring direct materials (determined above to be $.43$).

$$\begin{aligned} \text{DIRECT MATERIAL} &= [\text{DIRECT MATERIAL CRAFT HOUR RATIO}] \times \\ \text{PRODUCTIVITY VARIANCE} & [\text{CHANGE IN PRODUCTIVITY RATIO}] \times \\ & [\text{BUDGETED TOTAL PROJECTED HOURS AVAILABLE}] \\ & \times [\text{PORTION REQUIRING DIRECT MATERIALS}] \end{aligned}$$

$$\begin{aligned} &= [\$1.85/\text{hr}] \times [-.07] \times [39,520 \text{ hrs}] \times [.43] \\ &= \underline{\$-2,200.67} \end{aligned}$$

The total productivity variance is:

$$\begin{aligned} \text{TOTAL PRODUCTIVITY VARIANCE} &= [\text{DIRECT}] + [\text{INDIRECT}] \\ &= [\$-2,200.67] + [\$-2,904.72] \\ &= \underline{\$-5,105.39} \end{aligned}$$

The negative sign indicates that the shop was performing considerably under capacity.

4. Distribution Variance. This variance measures deviations caused by a shift toward or away from projects that consume direct materials. This shift could be caused by changes in portion of unscheduled maintenance, in the availability of complex work requiring direct materials, or from emergency conditions (hurricanes). These causes are largely beyond the shop supervisor's control; those that can be controlled are the responsibility of organization-level managers (policy concerning large projects and scheduled maintenance).

The magnitude of this variance is determined by multiplying the budgeted direct material craft hour ratio times the budgeted total productive craft hours (effects of changes in productivity having been isolated) times the change in the ratio of work requiring direct materials. This difference is the actual minus the budgeted targets or .03 (.43 - .40). The distribution variance is:

$$\begin{aligned} \text{DISTRIBUTION VARIANCE} &= [\text{DIRECT MATERIAL CRAFT HOUR RATIO}] \times \\ &\quad [\text{BUDGETED TOTAL PRODUCTIVE HOURS}] \times \\ &\quad [\text{DIFFERENCE IN RATIOS}] \end{aligned}$$

$$\begin{aligned} \text{VARIANCE} &= [\$1.85/\text{hr}] \times [27,664 \text{ hrs}] \times [.03] \\ &= \underline{\$1,535.35} \end{aligned}$$

The positive sign indicates that more work requiring direct materials was accomplished than planned.

5. Summary Variance.

<u>Variance</u>	<u>Indirect</u>	<u>Direct</u>	<u>Total</u>
Material Usage	\$-1,074.53	\$-1,155.12	\$-2,229.65
Assignment	2,063.88	1,563.63	3,627.51
Productivity	-2,904.72	-2,200.67	-5,105.39
Distribution	<u>-</u>	<u>1,535.35</u>	<u>1,535.35</u>
Summary	<u>\$-1,915.37</u>	<u>\$ -256.81</u>	<u>\$-2,172.18</u>

Note that the summary variance for each class of material is equal to the difference between the budget and the actual expense for each item (allowing for round-off error). See Table I.

C. APPLICATION

To illustrate how variance analysis provides detailed management information not previously available, Table I summarizes the results from the previous subsections. The left-hand portion of the table is typical of the information provided by existing reports.

The financial reports indicate that the unit is in good financial condition. Overall the shop is 4.4 percent under

TABLE I
A PRACTICAL EXAMPLE OF VARIANCE ANALYSIS APPLIED TO A GOVERNMENTAL UNIT

INFORMATION PROVIDED BY EXISTING REPORTS			ANALYSIS	ADDITIONAL INFORMATION PROVIDED BY VARIANCE ANALYSIS		
ACTUAL EXPENSES	BUDGET TARGET	DIFFERENCE	%	INDIRECT VARIANCE	DIRECT VARIANCE	TOTAL VARIANCE
\$27,131.83	\$29,047.20	\$-1,915.37	-6.6	\$-1,074.53	-	\$-1,074.53
20,214.56	20,471.36	-256.80	-1.3	-	\$1,155.12	-1,155.12
<u>\$47,346.39</u>	<u>\$49,518.56</u>	<u>\$-2,172.17</u>	<u>-4.4</u>	<u>\$-1,074.53</u>	<u>\$1,155.12</u>	<u>\$-2,229.65</u>
20.5*	19.0	1.5	7.9	2,063.88	1,563.63	3,627.51
2,080.0	2,080.0	2,080.0	-	-	-	-
42,640.0	39,520.0	3,120.0	7.9	-	-	-
26,863.2	27,664.0	-800.8	-2.9	-2,904.72	-2,200.67	-5,105.39
11,551.2	11,065.0	486.2	4.4	-	1,535.35	1,535.35
* IMPLIES 1 WORKER ASSIGNED FOR 1/2 YEAR.				<u>\$-1,915.37</u>	<u>\$-256.81</u>	<u>\$-2172.18</u>

budget target for the year. An experienced manager will be concerned by the lower productivity reported; however, no existing report links labor productivity with the financial management reports. Were the shop supervisor to set as an autonomous objective, based on the current labor reports, of operating the shop at full productivity, the shop would be \$5,162.86 (or 10 percent) overspent (determined by setting the Material Usage = Productivity Variance = 0.0).

The autonomous causes of added personnel being assigned and the decision to spend more effort in direct materials type work were both beyond the shop supervisor's ability to control. However, under conventional reporting, the supervisor's financial report would assign any deviation caused to his shop. Variance analysis then can isolate external causes and can quantify the impact of a decision made for other than financial reasons.

D. SUMMARY OF ADVANTAGES OF VARIANCE ANALYSIS

Managers have readily available, pertinent financial data. Previously financial management data was summarized at the organization level and either not available to the shop supervisor or was available only with considerable unnecessary data.¹² Variance analysis reports only exception data to the applicable managers. For example, in the above case the shop supervisor would receive reports only on the material usage and productivity variances, personnel would receive the assignment variance reports, and work planning the distribution variance reports.

Problems can be isolated to the manager most capable of correcting them. The data representing existing reports on Table I indicate only one area of concern--productivity. Variance techniques indicate that there are several problems, each related to a different cause and responsible supervisor: excessive number of personnel assigned for the budget, low productivity, low materials usage, and high use of direct materials type work. In this example the net effects of these causes balance out and are thus obscured in the existing reports, whereas variance analysis pinpoints problem areas for each manager.

The impact of managerial decisions are quantifiable. The general supervisor's decision to spend more effort in work consuming direct materials is not reflected on the existing reports. Variance analysis not only isolates the cause but also assigns a dollar magnitude to it. This advantage is of great importance in future decision making. Assume that a shop has a material crafthour ratio of \$2.00 per hour, and that a manager must decide between two projects: (1) one requiring \$9,500 and 5,000 hours to complete, the other (2) requiring \$4,000 and 800 hours to complete. In times of tight funding, the manager may be tempted to decide in favor of the lower cost project (No. 2). However, by applying variance analysis it can be seen that this project would cause a large negative impact on the budget, since its material crafthour ratio is \$5.00 per hour ($\$4,000/800$ hours). Thus for every hour worked the unit would be spending \$3.00

more than its budget, or a total of \$2,400 ($\$3.00/\text{hr} \times 800$ hours). The more expensive project, in turn, has a material craft-hour ratio of \$1.90 per hour ($\$9,500/5000$ hours) or \$.10 less per hour than budgeted. Thus, for every hour worked the unit would save \$.10, or a total of \$500.00 ($\$.10/\text{hr} \times 5000$ hours) for the project.

Variance analysis necessarily involves and motivates the first-line supervisor. Variance reports typically go to all levels of management. Knowing that his/her variances are reviewed by senior managers, the line supervisor will seek to correct deviations before they become significant to higher management. Since the reports are issued only when a variance occurs (exception basis), the manager will strive to get a clean slate (i.e., no reports), an action that will keep the unit on its budget targets.

Senior managers maintain the control they now have. In an age of tight federal appropriations, any proposal to decentralize financial management responsibility must satisfy higher management's need to maintain firm over-all control. Variance techniques maintain this control in that senior managers assign these budget targets. Through summary reports, they can monitor each branch's activity and keep track of their financial strength. As deviations begin to occur, these managers can become aware of them in time to make necessary decisions to preclude major funds problems.

Variance analysis provides clear justification for budget increases, since it isolates causes external to the

unit. This analysis can quantify the impact of higher headquarters decisions (for example, the increased number of personnel assigned in the example), and thus provide justification to the same headquarters for additional funding.

Variance analysis is highly adaptable to variable budgeting techniques. While the above example dealt with variance analysis in one particular formulation, variances can be defined wherever a variable budget can be developed. Variances are simply a quantifiable measurement of the deviation from each component of the variable budget equation. As such, variance analysis becomes more indispensable as variable budgets become more accepted in the Department of Defense.

Finally, given that the basic variable budget format can be automated, variance analysis is an easily programmable addition to that program.

E. FURTHER REFINEMENTS

By application of statistical techniques to variance analysis, the reports received by the shop supervisors would increase in utility. For example, the reports should have upper and lower control limits established so that an exception report would only be published if these limits were exceeded. If the tolerance level for the Distribution Variance were $\pm \$1,600.00$, the variance in the above sample would not be printed (actual value \$1,535.35). This technique allows managers and quality control personnel to concentrate their efforts on the more serious deviations. As

more shops fall within these control limits, they can be again tightened to provide closer control ("fine-tuning" the system). Alternatively, these control limits could be a function of the level of supervision. The closer to the problem area a supervisor is, the tighter these control limits. Thus, first-line managers are made aware of slight deviations, while general managers are informed of deviations on a much larger scope as is consistent with their level of responsibility.

In addition, after a few years of data had developed, the industrial engineers could apply statistical techniques to mask out the effects of price increases (beyond the unit's control), seasonal fluctuations in consumption (e.g. a refrigeration shop), or statistically insignificant data (i.e. "noise"). With each of these refinements the same objective as above prevails: to provide the first-level manager with all the information he/she needs to the detail required and only the information that the supervisor can do something about.

IV. CONCLUSIONS

Wherever variable budgets can be developed, variance analysis warrants implementation. It provides all levels of management with more sophisticated tools for controlling supply and personnel costs so critical to the DoD budget. Moreover, it provides both the means and the incentive for involving the first-line supervisor in the day-to-day financial well-being of the unit and of the armed forces as a whole.

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VITA

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